

New Design Paradigms Workshop
July, 2002

More Than the Sum of the Parts:
Groups, Representations and Design Interaction

Approach • Study in progress • Opportunities for visual representation

What makes a group more than the sum of its parts?

Emergence of novel design ideas

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Knowledge coordination and creation

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Shared mental models, commitment, consensus

Investigators' Perspectives

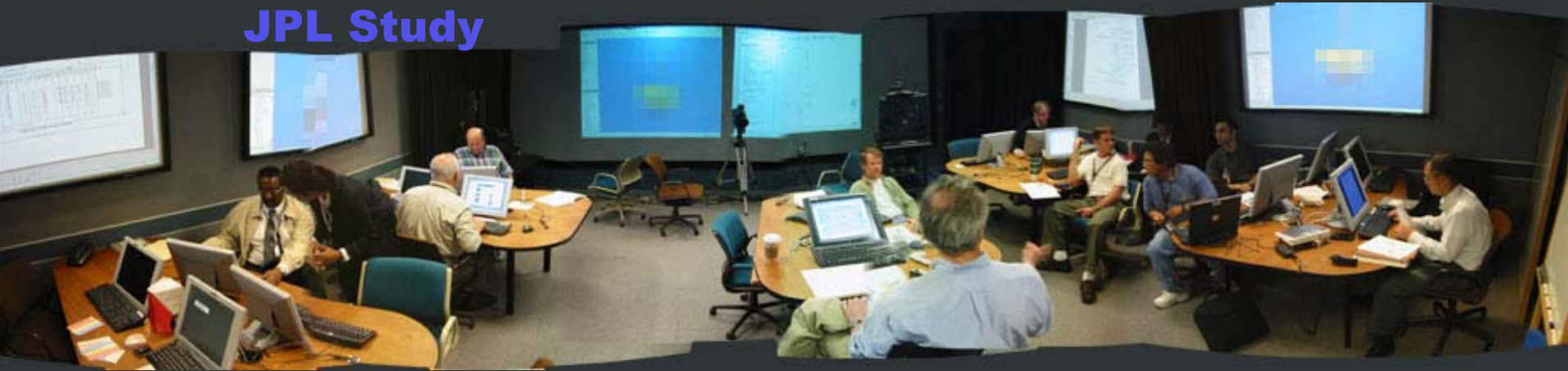
Creative collaboration

- *How groups generate ideas that individuals wouldn't have had*
- *Interaction dynamics between participants and external visual representations*
- *Facilitation of groups undertaking complex organizational projects*

Transactive memory

- *How a group manages what is known by its members*
- *Information allocation, encoding, retrieval*
- *Computational modeling of exception handling and technical project team performance*

JPL Study



Facilitated team, aerospace design domain experts

Observation of 9 working sessions (3-4 hrs each)

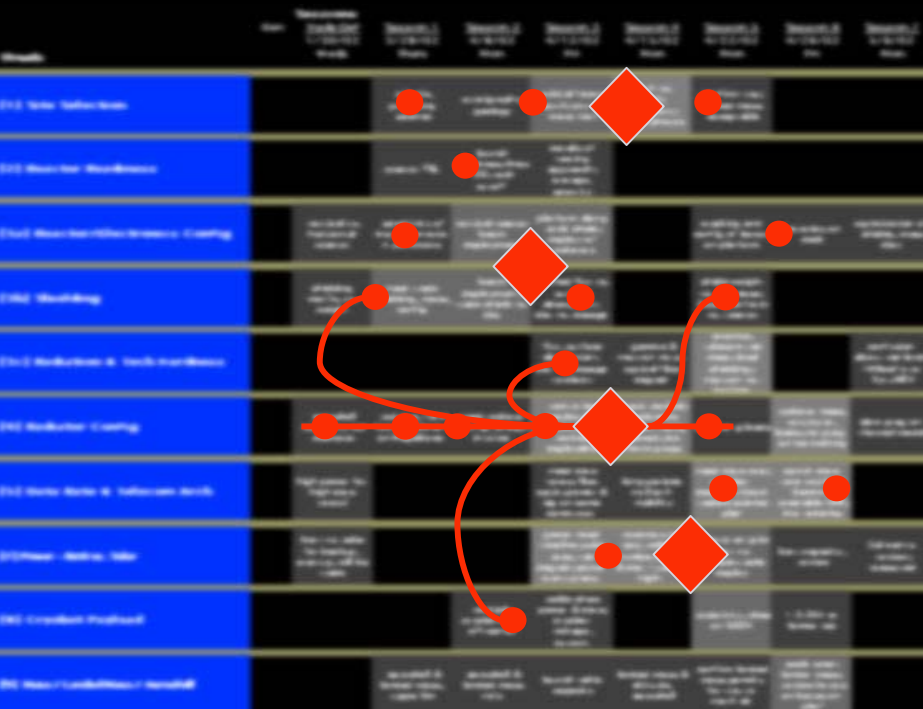
Real-time design with advanced simulation and modeling tools

Individual & background interviews

Co-located, dedicated space with shared displays

Video/audio recording, design system data and display system log

Exploratory Analysis (in progress)



Categorize Issue Threads

Locate Key Design
Emergence

Track Exception Detection
and Handling

Detailed Interaction
Analysis

What We've Seen

- (a) ■ Individual knowledge is interwoven in instances of design emergence
- (b) ■ Pro-active exception handling and transactive memory processes in operation
- Knowledge creation
- (c) ■ Rapid closure on complex cross-domain decisions
- Breakdowns and opportunities for improved representational support

(a) Processes underlying emergent design ideas

Serendipitous discovery – and outright mistakes – play a role

Characterized by fluid transitions and unpredictable combinations

Complex interaction dynamics accompany recognition of relevance, consensus and decision closure

(b) Knowledge creation in exception handling

Design or context

- *solutions and design alternatives*
- *enabling technologies*
- *mission environment, constraints*

Expertise

- *who knows what*

Interdependencies

- *task structure & decision making*



(c) What roles do external representations play?

Keep information present;
stabilize conversation

Engage diverse, sometimes
tacit knowledge

Make assumptions visible;
provoke questions

Invite participation, gain
credibility, organize consensus,
engender commitment

Span boundaries

Accelerate closure

Support creation of new
meaning, not just presentation
of pre-existing information

Clearly evident \longleftrightarrow **Proposed**

(c) Avenues for improvement – fluency

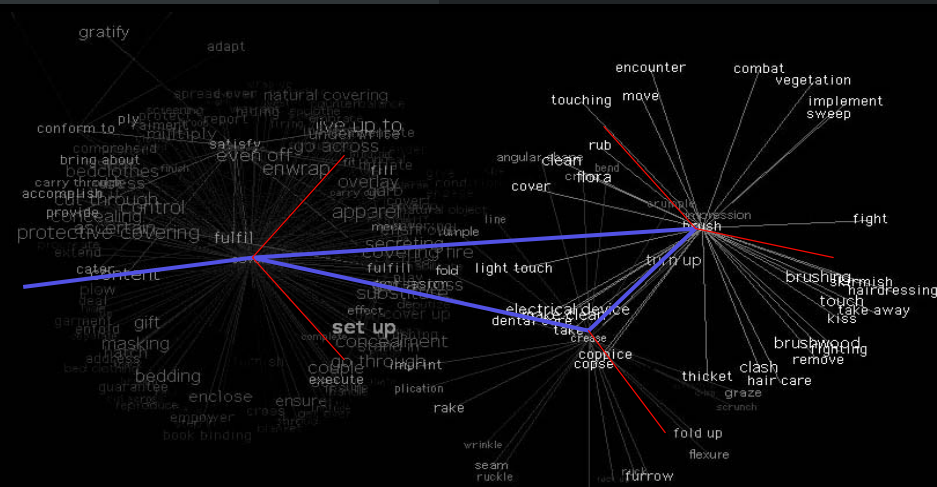
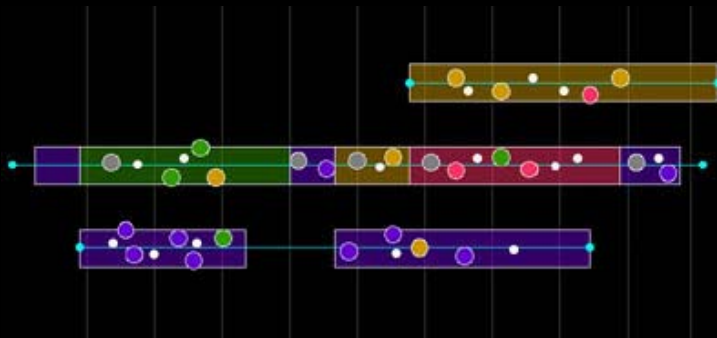
Speed

Data sharing

Quality of interface

Develop distinct practice and technique
appropriate to real-time concurrent situation

- *static CAD models don't capture sequences and time dimension*
- *potential to capture design rationale and evolving trade space real-time rather than relying solely upon post-hoc text reports*



(c) Avenues for improvement – interaction

Visualize the design context

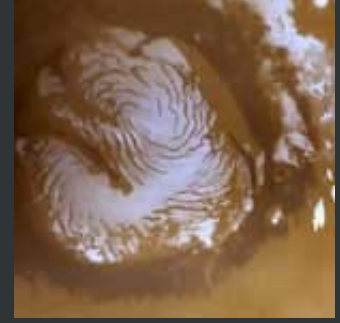
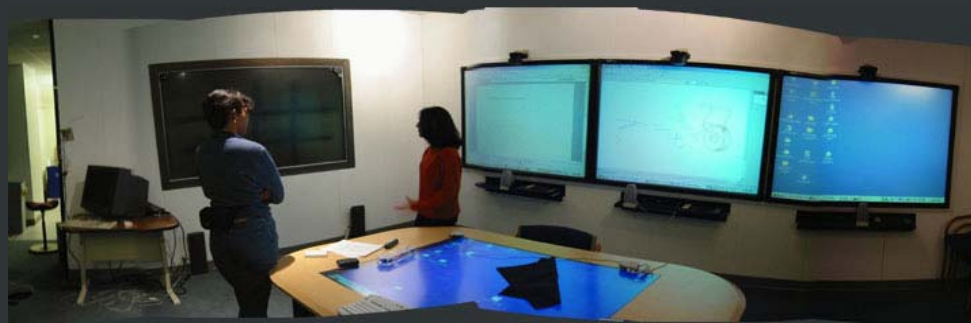
- *awareness, diverse knowledge & experience, immersion*

Afford direct participation

- *support multi-person interaction with technology*

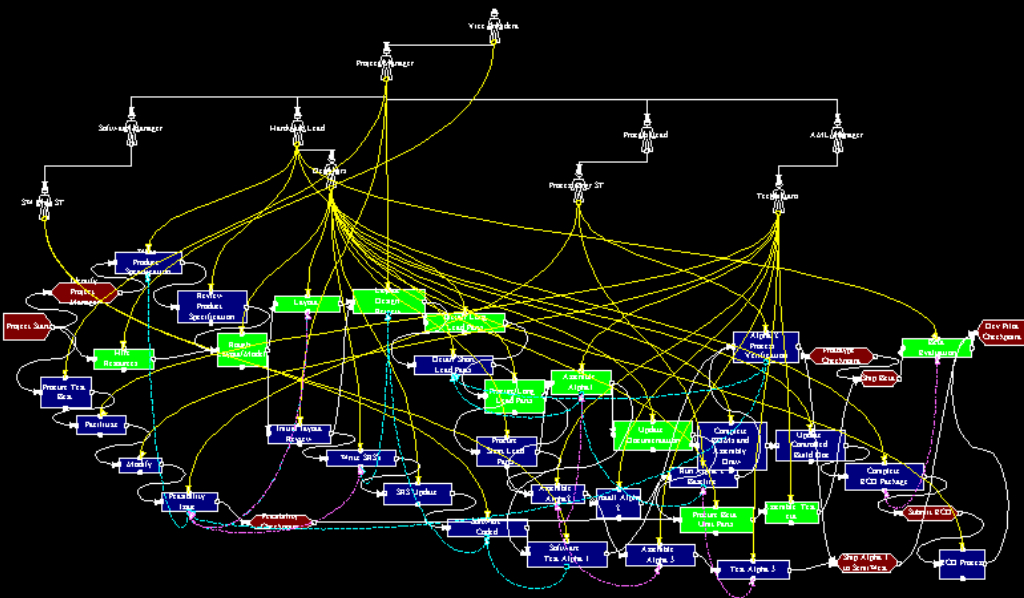
Facilitate collage

- *allow for heterogeneity of sources and media*



(c) Avenues for improvement – organization

Organization structure and process alongside design of product (*visualize, model, design*)



Research Relevance

Knowledge Management

- *coming to terms with the collective, not just the individual dimensions of knowledge*

Cooperative Work

- *understanding what is most valuable to leverage opportunities for co-presence*

Psychology, Social Psychology & Group Dynamics

- *how representation becomes a participant in cognition and interaction*
- *dynamics of individual participation and group commitment*

Design & Product Development

- *seeing innovation embedded within routine*

Contact:

Presenter:

Ben Shaw

PhD Candidate, Royal College of Art, London

Visiting Researcher, Knexus Center, Stanford University

<bgshaw@stanford.edu>

Co-Investigator:

Monique Lambert

PhD Candidate, Civil & Environmental Engineering, Stanford University

<mhlamber@stanford.edu>

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